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Senior High School Curriculum Guide

for

SCIENCE 10

(Interim Edition)

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ACKNOWLEDGMENT

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Senior High School Curriculum Committee:

Morrison L. Watts...Director of Curriculum (Chairman)
A. B. Evenson.....Associate Director of Curriculum
H. C. Sweet.....High School Inspector, Edmonton
C. B. Johnson.....High School Inspector, Lethbridge
A. W. Reeves.....High School Inspector, Edmonton
T. C. Byrne.....High School Inspector, Edmonton
G. L. Mowat.....High School Inspector, Calgary
D. M. Sullivan.....Registrar, Department of Education
H. T. Sparby.....Faculty of Education, Edmonton
G. R. Conquest.....Director of Secondary Education and Guidance, Edmonton Public School Board
F. L. Woodman.....Principal, Western Canada High School, Calgary
R. E. Byron.....Supervisor of Industrial Arts, Department of Education
E. J. M. Church.....Supervisor, Teacher Service Bureau, Department of Education.
A. A. Aldridge.....Supervisor of Guidance, Department of Education
H. D. Cartwright....Principal, Crescent Heights High School, Calgary
H. T. Coutts.....Faculty of Education, Edmonton
G. F. Bruce.....Director, Correspondence School Branch, Department of Education.

Subcommittee on Senior High School Science

G. L. Mowat.....High School Inspector (Chairman)
R. V. Clark.....Garneau High School, Edmonton
R. Turner.....Lethbridge Collegiate Institute
W. J. Hoover.....Crescent Heights High School, Calgary
H. C. Melsness.....Faculty of Education

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PHYSICAL SCIENCE

Introduction

Science 10 is a course centered on a group of subjects known as the physical sciences. The term "physical sciences" when used to describe the contents of science courses, implies a reorganization of subject matter and concepts drawn from the whole science field, rather than rejection of the contents of the more familiar specialized science courses—chemistry, physics and geology.

The reasons for this reorganization are related to the status of science information as a major determinant of our way of thinking and acting. The records of mankind reflect consistently and clearly man's struggle to understand and control the various elements of his environment. He has sought knowledge and understanding of both the animate and the inanimate. At any particular time in history, man's economy, his politics, his philosophy and his religion have been affected by what he believed with respect to the physical world; these aspects of his life were modified as his beliefs changed and expanded. Activities within the field of science, whether intellectual or practical, contributed to this change, and to a major extent the degree of understanding of the people as a whole gave impetus to the shedding of the dogma, superstition and drudgery of earlier generations.

In contrast to the limited contacts and experiences, and the relatively isolated existence of earlier days, our present day thinking and acting come under immediate impact of what happens throughout the world. Particularly, science discoveries have accelerated and pyramided, and the speed with which we are acquiring new knowledge has set the tempo of our age. Each major discovery bears its accompanying social and economic problem; each major discovery has national and international implications.

The education of youth must provide a basis not only for understanding and attacking problems within our society, but also for developing some insight into the role of science in the lives of young people. Science education must develop habits, attitudes and understandings over and above the facts of science.

The amount of science information has expanded manifoldly during the last decade. There are within the whole field of science many distinct areas, each of which constitutes a body of information in which a lifetime of specialized study may be undertaken. Such courses, treated in states of independence, have specific places and indispensable values in education. The elementary facts of science, upon which such courses are based, have been organized in our schools in a similar fashion, upon a "vertical" basis, so to speak, and have been known as Physics, Chemistry and Geology.

The elementary facts of science which are taught in our schools must be considered to be the vehicle used to achieve *all* the objectives of science education. Not only are they significant in that they equip the students with accurate information; they are the parts from which habits, attitudes, understandings, and ways of thinking and acting will be developed. The organization of the content of any science course may be a significant factor in facilitating this process.

The Physical Sciences contain these elementary facts, gathered from physics, chemistry, geology and meteorology, and organized to develop important concepts. This arrangement attempts to ignore the artificial boundary between physics and chemistry, for example, whenever related facts and principles may be drawn from both to develop a topic being studied. In keeping with the contribution which science education may make to all students, this organization of subject matter is deemed most suitable.

The responsibility of the schools to provide science education suited to all, as well as to equip those with special ability to proceed with more advanced science education, is acknowledged and met by this reorganization. Specifically, Science 10 and Science 20 will serve two purposes:

(1) They will provide a two-year science education of a type suited to all students.

(2) They will, in addition, provide a basis upon which any student may undertake Grade XII science courses, and thereby satisfy university entrance requirements.

Objectives of Science Education

The major objective of these courses is to assist in achieving the general aim of education through the medium of experiences in the field of physical science.

These experiences will contribute more towards the realization of some educational objectives than towards others. The following discussion of objectives of science education is based upon statements reported in *The Forty-Sixth Yearbook of the National Society for the Study of Education*:

1. **To acquire useful facts and information concerning the environment and to develop functional concepts and an understanding of scientific principles.**

   This objective is concerned with the acquiring of a body of information useful to the student, the developing of such concepts as are listed before each unit, and the understanding of such principles as are related to the concepts.

2. **To acquire an appreciation of the scientific, or problem-solving method, and to develop an ability to use it.**

   The following are listed as elements, or steps, in using this method:

   a. Becoming aware of a problem.
   b. Gathering information bearing on the problem.
   c. Suggesting possible explanations or procedures and selecting the most promising.
   d. Testing the procedure chosen.
   e. Drawing conclusions.

3. **To acquire instrumental skills** such as the folowing:

   a. Reading science content with understanding and satisfaction.
   b. Performing simple manipulations with science equipment.
   c. Taking accurate measurements and readings.

4. To develop desirable attitudes, interests and appreciations.

Attitudes

These include:

a. The attitude of open-mindedness, or willingness to consider the facts.

b. The attitude of critical judgment enabling one to distinguish between facts and superstitions.

c. The attitude of willingness to withhold judgment until sufficient evidence has been gathered.

Interests

These include developing interests in some phase of science as a hobby, or as something which may be of guidance in choosing a vocation.

Appreciations

These include an appreciation of:

a. the relation between cause and effect,

b. the contributions of scientists to present day knowledge,

c. the part science plays in modern life.

These objectives describe the functions of science teaching. Rather than being absolute goals, they represent directions of growth along which some progress may be made.

THE PHYSICAL SCIENCE PROGRAM

The Physical Science Program consists of two courses—Science 10, and Science 20. The contents of these courses are contained in *one* text which is authorized for students' use. Suitable secondary references are listed.

The scope of the above courses is as follows:

Science 10

UNIT 1 THE NATURE OF THINGS
- Atoms and Molecules
- Molecules in Motion
- Air, An Important Mixture
- Water, An Important Compound
- Water for Machines

UNIT 2 THE EARTH
- The Earth and Its Motions
- Rocks of the Earth
- The Changing Earth
- Life in Earth History

UNIT 3 TEMPERATURE AND HEAT
- What is Temperature?
- What is Heat?
- Expansion
- How Heat Travels
- Evaporation and Boiling

Articulation Among the Elementary, Junior High and Senior High School Science Programs

ELEMENTARY	JUNIOR HIGH	SENIOR HIGH	
Grades I-VI	**GRADES VII-IX**	**Grades X, XI**	**Grade XII**
Living Things	Life	Biology	Biology
Earth and the Universe	Earth and the Universe	Physical Science	Chemistry
Energy and Machines	Work, Energy, Machines and Man	Physical Science	Physics

UNIT 4 WEATHER
Winds and Air Masses
Fronts and Storms
Weather Forecasting
What is Climate?

UNIT 5 FIRE AND FUELS
What is Fire?
Oxidation
Fires and Explosions
The Control of Fire
Oil and Its Origin
Coal and Its Origin
Fuel Gases
The Carbon Dioxide Cycle

UNIT 6 POWER FROM COMBUSTION
Machines
Steam Engines
Internal-Combustion Engines
The Airplane
Gas Turbines, Jets, Rockets.

SCIENCE 20

UNIT 7 ELECTRICITY
What is Electricity?
Electric Currents
Magnetism
Electric Power
Heat and Light from Electricity

UNIT 8 LIGHT
Artificial Light
Light and Its Effects
Optical Instruments
What is Color?

UNIT 9 COMMUNICATION
What is Sound?
Sound Instruments
The Telegraph and Telephone
Radio and Electronics

UNIT 10 STRUCTURAL MATERIALS
Iron, an Important Metal
Steel, a Material for Construction
Copper and Zinc
Aluminum and Magnesium
Glass and Cement

UNIT 11 THE CHEMICAL NATURE OF THINGS
- Chemical Activity
- Acids, Bases, Salts; Ionization
- Symbols, Valence, Equations, Formulas
- Chemical Industries
- Chemistry and the Consumer

UNIT 12 THE UNIVERSE
- The Sun
- The Sun's Family
- Comets, Meteors, and the Moon
- Beyond the Solar System
- Energy from Atoms
- Chemical and Nuclear Energy

Suggested Time Allotment

Teachers should plan their year's work in Physical Science so that all Units receive attention. No prescribed time is being laid down for each Unit, as the time consumed will vary according to the interests and abilities of the class. More time can be given to Units in which class interest and participation are high than is given to Units which may prove to be of lesser interest. However, for the benefit of students who will proceed to later studies in Physics and Chemistry, it is essential that every Unit be given its fair share of time during the year.

REFERENCES

Primary References:

Hogg, Cross, et al., *Physical Sciences for Canadian High Schools.* (Each student should have a copy).

Secondary References:

Eby, Wargh, Welch and Buckingham, *The Physical Sciences.*

Basic Science Education Series:

No. 39 Our Ocean of Air
40 Fire Friend and Foe
43 The Ways of the Weather
47 Heat
48 Earth's Changing Surface
57 Soil
68 Matter and Molecules

General References:

Cable, Getchell and Kadesh, *The Physical Sciences.*

Dull, *Modern Physics.*

Black and Conant, *New Practical Chemistry.*

Teachers' References

Cheronis, Parsons and Ronneberg, *A Study of the Physical World.*
It is strongly recommended that each teacher have a copy of this reference as a source of information which goes beyond that contained in any other reference listed.

Jean, Harrah and Powers, *Man and His Physical Universe.*

National Society for the Study of Education, *Science Education for American Schools.* (Part I, Forty-Sixth Yearbook).

Heiss, Obourn and Hoffman, *Modern Science Teaching.*

Hoff, *Secondary School Science Teaching.*

Periodicals

School Science and Mathematics.
450 Ahnaip Street, Menasha,
Wisconsin, U.S.A. $4.00 per year.

The Science Teacher.
National Science Teachers' Association,
1201 Sixteenth Street N.W.,
Washington 6, D.C., U.S.A.,
$3.00 per year.

Other Sources of Material:

Meteorological Division, Department of Transport, Edmonton or Calgary.

Department of Mines and Technical Surveys, Ottawa.

Public Relations Department, Imperial Oil Limited, Edmonton or Calgary.

Dominion Bureau of Statistics, Department of Trade and Commerce, Ottawa.

Superintendent of Documents, Washington 25, D.C., U.S.A.

Magazines:

Canadian Nature Magazine,
177 Jarvis Street, Toronto 2, Ontario.

Canadian Geographical Journal,
36 Elgin Street, Ottawa.

National Geographic Magazine,
Washington, D.C., U.S.A.

Physical Science Course Organization

Each of the six units in Science 10 and 20 is organized and developed according to a definite pattern.

1. For each unit there is listed a **Major Concept,** which is intended to suggest the central theme of the unit.

1. Contributing to the development of this Major Concept are listed a number of **Generalizations.**

3. The body of each unit is arranged under three headings: Specific Purposes, Suggested Activities and Understandings.

   a. **Specific Purposes**
   Each Specific Purpose is intended to establish the relationship of a given part of the unit to one or more Generalizations listed; each Specific Purpose is a minor objective.

   b. **The Suggested Procedures**
   These are avenues of approach from which the teacher may choose, or for which the teacher may substitute others, in order to achieve the Specific Purposes.

c. **Understandings**

The understandings are facts, principles and other conclusions from the sum total of which the generalizations of the unit will emerge.

NOTE: The unit is not complete when the understandings have been achieved. It still remains to draw from the understandings clear enunciations of the Generalizations, and in turn the central theme, or Major Concept.

Commencing with the Major Concept as an objective, and following throughout the various parts of the outline, the development of the unit follows a cycle which is complete when the Major Concept has been developed.

Example of Unit Organization **Science 10**

UNIT 1 THE NATURE OF THINGS

1. **References:**

Hogg, Cross, et al, *Physical Sciences for High Schools*. pp.19-66.
Eby, et al., *The Physical Sciences*. pp. 431-444.
Black and Conant, *New Practical Chemistry*. pp. 13-30.
Dull, *Modern Physics*. pp. 3-105.

2. **Major Concept:**

Theories regarding the structure of matter and an understanding of its composition and properties help to explain many of the facts and principles of science.

3. **Generalizations:**

a. Matter exists in the form of elements, compounds and mixtures. (Specific purposes 1, 2, 3, 6 and 7.)
b. Each element and compound has definite properties by which it may be identified. (Specific purposes 1, 2 and 3.)
c. The atoms and molecules of which matter is composed explains the properties and behavior of various kinds of matter. (Specific purposes 4 and 5.)
d. Man uses his understanding of the properties of matter to his advantage. (Specific purpose 8.)

UNIT 1.—THE NATURE OF THINGS

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
1. To identify and recognize the properties of matter in each of its three states.	a. Examine a variety of specimens of matter. b. Make a list of many materials, and group them into solids, liquids, gases.	a. There are three states of matter—solids, liquids, and gases. b. All forms of matter have certain properties in common.
2. To distinguish between mixtures and pure substances.	a. Examine more closely the specimens above, and divide them into mixtures and pure substances. b. Separate one or more mixtures into their constituents.	a. Most solids, liquids and gases are mixtures; the rest are pure substances. b. Mixtures may be separated into their constituents by a mechanical process.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
3. To understand the meanings of the terms Elements and Compounds.	a. Examine a number of pure substances with a view to distinguishing between elements and compounds. b. Study the use of these terms by early philosophers and scientists. c. Make a compound from its elements. d. Decompose a compound into elements.	a. Compounds are not distinguished easily from elements. b. An element is a substance that cannot be decomposed by chemical treatment. c. There are about one hundred different elements, several thousand different compounds, and an unlimited number of mixtures of these. d. Heat and electricity are two chief agents used to decompose compounds or unite elements.
4. To establish our present theory of the structure of matter.	a. Study solution and evaporation to demonstrate the spaces between molecules. b. Study illustrations and diagrams of molecules and atoms. c. Compare the properties of a compound with the characteristic properties of its elements.	a. Matter is composed of molecules with spaces between them. b. A molecule consists of one or more atoms. c. Atoms are the unit of elements; molecules are the unit of compounds. d. Molecules and atoms each have specific characteristic properties. e. The atom consists of a nucleus and planetary electrons.
5. To develop a realization of the significance of molecular motion in relation to the properties of matter.	a. Study the processes of solution and diffusion to demonstrate molecular motion. b. Illustrate molecular motion by reference to the Brownian movement. c. Demonstrate cohesion and adhesion.	a. All molecules move. b. The state of any substance is related to the speed of its molecules. c. The higher the temperature the farther the molecules *move*. d. Evaporation, diffusion, Processes of solution and gaseous pressure are related to molecular motion. e. Cohesion and adhesion are forms which determine the degree of freedom of motion of molecules.
6. To acquire accurate knowledge of an important mixture—air.	a. Demonstrate that air has weight and exerts pressure. b. Construct a simple mercury barometer, and note variations with respect to altitude and weather changes.	a. Air has weight and exerts pressure. b. Air pressure can be measured by means of barometers. c. Air pressure varies with changes in altitude and weather conditions.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
	c. Find proportions of the constituents of air. d. Remove oxygen from air and note the properties of the residual gases.	d. Air contains several gases mixed in a relatively uniform proportion. e. The chemically active part of air is oxygen; the inactive part is mostly nitrogen.
7. To acquire accurate knowledge of an important compound—water.	a. Study the use of water in Alberta for irrigation, power, industry, sanitation. b. Investigate the problems of water supply and conservation in Alberta. c. By investigation and experiment, study how natural water may be prepared for man's use. d. By electrolysis, show that water is a compound.	a. Water is an important natural resource and should be conserved. b. Water is the most common solvent. c. Natural water contains many substances in solution which affects its uses. d. Water can be decomposed by electricity into hydrogen and oxygen.
8. To develop a realization of the importance of water and air in relation to work.	a. Demonstrate the laws of liquid pressure. b. Demonstrate Pascal's Principle of the transmission of fluid pressure. c. Demonstrate Archimedes' Principle and the principle of flotation. d. Study several applications of the above principles. e. Study how man converts the energy of moving air and water into work.	a. Because of its weight, water exerts pressure. b. Water may be used to transmit pressure. c. Buoyancy is an important characteristic of both water and air. d. The kinetic energy of water and air may be used by man to do work.

5. Summary of Activities

1. Collect a large number of specimens of matter for classification.
2. Make a compound from two elements.
3. Decompose a compound into elements.
4. Make a solution of a solid; obtain crystals.
5. Make a solution of a gas; boil a gas out of a solution.
6. Soften glass by heat.
7. Demonstrate Brownian movements.
8. Demonstrate cohesion and adhesion.
9. Weigh a sample of air.
10. Show that air exerts pressure.
11. Construct a mercury barometer.
12. Remove the oxygen from a sample of air.
13. Soften hard water.
14. Remove dirt from water by sedimentation and filtration.
15. Distill some salt water.
16. Decompose water by electrolysis.
17. Demonstrate the laws of liquid pressure.
18. Demonstrate Archimedes' Principle and the principle of flotation.

The Problem-solving Method

The taking of a science course does not develop, necessarily, the desired ability in the students to utilize the problem-solving method. It may be conceded, however, that science education can contribute most effectively to the ability to use the problem-solving, or scientific method, if the objective is held clearly by science teachers.

If an experiment be performed in the "cut and dried" manner in which the directions are prescribed, the outcomes predetermined, and in which the student merely corroborates the given results, certain objectives other than practice in using the scientific method may be achieved. Such "experiments" are, however, more in the category of demonstrations to clarify or illustrate visually relationships and principles.

Using the terms broadly, **Experimentation and Demonstration** embrace that essential part of any science course which involves students working with equipment and materials to achieve some purposes above and beyond the activity itself. As a sequence in the achievement of such purposes among pupils, four steps may be listed:

1. The students become familiar with equipment, apparatus, and other materials, and in so doing add meaning to science terms which they should know.
2. The students demonstrate and clarify science principles and facts.
3. A certain amount of adherence to an outlined course of procedure, and to a certain form of recording results, familiarizes them with the elements of the scientific method.
4. The students utilize the knowledge and skills acquired as above, to apply the problem-solving method in new and meaningful situations.

This last step, which is the transfer of learning into actual practice, is most essential to the development of the ability to use the scientific method.

Ths is one major objective of science education. Teachers are urged to encourage, and to provide opportunities to students to solve suitable problems using the scientific method.

Evaluation

The evaluation program should serve at least two purposes:

(1) To measure pupil growth in the direction indicated by the objectives of the course.

(2) To appraise the effectiveness of teaching.

Facts, clearly understood by the students, are essential to the development of important concepts and principles. Testing the pupils' mastery of these facts will present few problems. It is more difficult, but equally important, to test habits, skills, understandings of concepts and principles, and attitudes. There have been interesting developments in measuring students' abilities to use aspects of the scientific method, and in measuring the growth of scientific attitudes. An excellent chapter on the evaluation of these is contained in *Modern Methods and Materials for Teaching Science,* Heiss.

Teachers are encouraged to utilize a testing and evaluation program in its fullest sense, so that an appraisal may be made of *what* is being accomplished (student), and *how* it is being accomplished (teacher).

Science and English

To teach students to use English correctly and effectively is an objective of all education, science included. Teachers of science have a responsibility to contribute to the achievement of this objective. As in other subjects, the regular assignment of written work will facilitate learning; this written work should be checked regularly by the teacher, returned to and corrected by the student. Adept, concise and grammatically correct written language must be a concern of all science teachers.

Audio-Visual Aids

The use of audio-visual aids is a practice of considerable merit under favorable circumstances. In order to have appropriate aids available when they parallel the topics being studied, schools and school divisions are urged to build up a filmstrip library. In this manner any filmstrips may be made available at the proper time.

Filmstrips, and both silent and sound films, are also available without charge other than the cost of mailing, from the Audio-Visual Aids Branch, Department of Education, Edmonton. Teachers should consult the catalogues of the Audio-Visual Aids Branch for information about securing films, and for descriptions of the films and filmstrips listed below. This branch can also supply information regarding the purchase of filmstrips.

Films and Filmstrips available for Science 10

The following films and filmstrips from the library of the Audio-Visual Aids Branch are suggested for use with the various units of the Science 10 course:

T—indicates sound film
Q—indicates silent film
P—indicates filmstrips

UNIT 1

4.	T-208	Molecular Theory of Matter
	P-1309	Kinetic Molecular Theory
	P-1310	Atomic Theory
5.	P-352-356	Matter and Molecules Series
6.	Q-8	Atmospheric Pressure
7, 8.	P-380-398	Fluids Series
	T-87	Hydraulics

UNIT 2

1.	T-8	Earth in Motion
	T-604	Latitude and Longitude
	P-963	Latitude and Longitude
	P-964	Longitude and Time
2.	T-197	Earth's Rocky Crust
	T-217	Volcanoes in Action

3.	P-260	How Rocks are Formed (J.H.)
	P-261	The Structure of the Earth We Find in Rocks (J.H.)
	P-299	Rocks (V.I.S.)
4.	Q-37	Formation of the Soil
	T-429	Wearing Away the Land
	T-264	Soil for Tomorrow
5, 6.	P-259	Our Earth is Changing

UNIT 3

2.	P-1068	Temperature (J.H.)
3.	T-74	Distributing Heat Energy
	P-1386	Distributing Heat Energy
	P-1076	Heat Transfer
5.	P-1073	Vaporization

UNIT 4

1.	T-218	The Weather
	T-350	Atmosphere and its Circulation
3.	P-1472	Understanding Weather Conditions
	P-1644	The Weather
4.	P-1673	Drama of the Clouds
	T-298	Water Cycle

UNIT 5

1.	T-92	Fuels and Heat
	Q-182	Fire Making
	P-1385	Fuels and Heat
3.	T-560	Oxygen
	P-244	Hydrogen and Oxygen
7.	T-299	Petroleum
	T-621	A Mile Below the Wheat
	T-40	Petroleum and its Products
	.....	As Old as the Hills
	P-1237	Oil in the Modern World
	P-1435	How We Get Our Oil
8.	P-1511	The Formation of Coal
	P-1429	How We Get Our Coal (Y.A.F.)
9.	P-1529	How We Get Our Gas

UNIT 6

1, 2.	T-27	Simple Machines
	P-896	Simple Machines
3.	P-346	Work
	P-347	Energy
	P-348	Power
5.	Q-188	Steam power
	Q-111	Gas Engine
	T-277	Diesel, Modern Power

General:

	T-79	Thermodynamics

UNIT ONE—THE NATURE OF THINGS

1. References:

Hogg, Cross, et al, *Physical Sciences for Canadian High Schools.* pp. 19-66.

Eby, et al, *The Physical Sciences.* pp. 431-444.

Black and Conant, *New Practical Chemisty.* pp. 13-30.

Dull, *Modern Physics.* pp. 3-105.

2. Major Concept:

The properties and behavior of matter are adequately explained by the atomic-molecular theory.

3. Generalizations:

a. Matter exists in the form of elements, compounds and mixtures. (Specific purposes 1, 3, 6, and 7.)

b. Each element and compound has definite properties by which it may be identified. (Specific purposes 1, 2, and 3.)

c. The atoms and molecules of which matter is composed explain the properties and behavior of vaious kinds of matter. (Specific purposes 4 and 5.)

d. Man uses his understanding of the properties of matter to his advantage. (Specific purpose 8.)

UNIT I—THE NATURE OF THINGS

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
1. To identify, and recognize the properties of matter in each of its three states.	a. Examine a variety of specimens of matter. b. Make a list of many materials, and group them into solids, liquids, gases.	a. There are three states of matter — solids, liquids, and gases. b. All forms of matter have certain properties in common.
2. To distinguish between mixtures and pure substances.	a. Examine more closely the specimens above, and divide them into mixtures and pure substances. b. Separate one or more mixtures into their constituents.	a. Most solids, liquids and gases are mixtures; the rest are pure substances. b. Mixtures may be separated into their constituents by a mechanical process.
3. To understand the meanings of the terms Elements and Compounds.	a. Examine a number of pure substances with a view to distinguishing between elements and compounds.	a. Compounds are not distinguished easily from elements. b. An element is a substance that cannot be decomposed by chemical treatment.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
	b. Study the use of these terms by early philosophers and scientists. c. Make a compound from its elements. d. Decompose a compound into elements.	c. There are about one hundred different elements, thousands of different compounds, and an unlimited number of mixtures of these. d. Heat and electricity are two chief agents used to decompose compounds or unite elements.
4. To establish our present theory of the structure of matter.	a. Study solution and evaporation to demonstrate the spaces between molecules. b. Study illustrations and diagrams of molecules and atoms. c. Compare the properties of a compound with the properties of its elements.	a. Matter is composed of molecules, with spaces between them. b. A molecule consists of one or more atoms. c. Atoms are the units of elements; molecules are the units of compounds. d. Molecules and atoms each have specific characteristic properties. e. The atom consists of a nucleus and planetary electrons.
5. To develop a realization of the significance of molecular motion in relation to the properties of matter.	a. Study the processes of solution and diffusion to demonstrate molecular motion. b. Illustrate molecular motion by reference to the Brownian movement. c. Demonstrate cohesion and adhesion.	a. All molecules move. b. The state of any substance is related to the speed of its molecules. c. The higher the temperature the faster the molecules move. d. Evaporation, diffusion, processes of solution, and gaseous pressure are related to molecular motion. e. Cohesion and adhesion are forms which determine the degree of freedom of motion of molecules.
6. To acquire accurate knowledge of an important mixture—air.	a. Demonstrate that air has weight and exerts pressures.	a. Air has weight and exerts pressures.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
	b. Construct a simple mercury barometer, and note variations with respect to altitude and weather changes. c. Find proportions of the constituents of air. d. Remove oxygen from air and note the properties of the residual gases.	b. Air pressure can be measured by means of barometers. c. Air pressure varies with changes in altitude and weather conditions. d. Air contains several gases mixed in a relatively uniform proportion. e. The chemically active part of air is oxygen; the inactive part is mostly nitrogen.
7. To acquire accurate knowledge of an important compound—water.	a. Study the use of water in Alberta for irrigation, power, industry, sanitation. b. Investigate the problems of water supply and conservation in Alberta. c. By investigation and experiment, study how natural water may be treated for man's use. d. By electrolysis, show that water is a compound.	a. Water is an important natural resource and should be conserved. b. Water is the most common solvent. c. Natural water contains many substances in solution which affect its uses. d. Water can be decomposed by electricity into hydrogen and oxygen.
8. To develop a realization of the importance of water and air in relation to work.	a. Demonstrate the laws of liquid pressure. b. Demonstrate Pascal's Principle of the transmission of pressure by fluids. c. Demonstrate Archimides' Principle and the principle of flotation. d. Study several applications of the above principles. e. Study how man converts the energy of moving air and water into work.	a. Because of its weight, water exerts pressure. b. Water may be used to transmit pressure. c. Buoyancy is an important characteristic of both water and air. d. The kinetic energy of water and air may be used by man to do work.

UNIT TWO—THE EARTH

1. References:

Hogg, et al, *Physical Sciences For High Schools.* pp. 71-116.
Eby, et al, *The Physical Sciences.* pp. 41-91.

2. Major Concept:

Life on the earth has been greatly influenced by constant changes which have been going on in the earth's crust for millions of years.

3. Generalizations:

a. The earth's shape and its movements influence our daily living. (Specific purpose 1.)

b. Forces are at work that cause slow but constant changes in the earth's crust. (Specific purposes 2, 3, and 4.)

c. The soil is one of our most important resources. (Specific purpose 4.)

d. The history of the earth and of various forms of life on the earth are revealed by the rocks and fossils found in the earth's crust. (Specific purposes 5 and 6.)

UNIT II—THE EARTH

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
1. To ascertain how the Earth's shape, position, and movements are used by man to indicate time and location.	a. Use suitable equipment and diagrams to study the shape and motions of the earth. b. Make observations of the angle of the slope of the sun's rays in relation to seasonal changes. c. Using a globe, review latitude and longitude. d. Study equinoxes and summer and winter solstices. e. Study the development of our present day calendar and its proposed reforms.	a. The Earth is a spherical-shaped planet, slightly flattened at the poles. b. The average period of rotation of the earth upon its axis is called a solar day. c. It moves in its orbit around the sun in 365¼ days. d. The Earth's axis being inclined, its orbital motion gives rise to seasons. e. Man has devised lines of reference called Latitude and Longitude, as a means of locating points on the earth's surface. f. Man also uses lines of Longitude to indicate time belts.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
2. To visualize the earth's interior as established by research and deduction.	a. Gather evidence concerning the nature of the interior of the earth—hot springs, well-drilling, meteorites. b. Gather information and report on famous volcanoes, and the history of their eruptions. c. Utilize charts, diagrams, and pictures to study the nature and causes of volcanoes and earthquakes.	a. The earth consists of a solid crust over plastic rock, with an iron-nickel core at its centre. b. The temperature of the earth increases with depth—1° F. for each 100 feet. c. The high temperature at the interior of the earth does not melt rocks because of the overlying pressure. d. When the pressure is released, molten rock flows out. e. When the lava in a volcano solidifies, the resulting build-up in pressure beneath may cause an eruption.
3. To become acquainted with the main types of rocks.	a. Acquire a large collection of rocks for study and classification.	a. Igneous rocks were once molten—e.g. basalt, granite. b. Sedimentary rocks are usually deposited in water—e.g. limestone, shale. c. Some sedimentary rocks are organic in origin—e.g. limestone, shale. d. Metamorphic rocks result from other types of rocks being under heat and pressure—e.g. slate, marble, anthracite.
4. To appreciate the significance to man of the continuous changes in the earth's surface.	a. Observe and record how the agents of erosion have moved rock materials locally. b. Gather information on all agents of erosion which cannot be directly observed.	a. Erosion is the transporting and re-depositing of rock material. b. Weathering may be either mechanical or chemical.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
	c. Study the effect of acid on limestone, of water on iron, and other similar reactions, and relate to chemical weathering. d. A study of conditions which might cause Alberta to become a "Dust Bowl", and of the steps being taken to avoid it.	c. Agents of erosion are wind, running water, glaciers, waves. d. Chemical action produces soils and gives rise to such forms as stalactites and stalagmites. e. Alberta farmers practice various methods of soil conservation.
5. To realize how the Earth's history may be read from the Earth's rocky crust.	a. Through observation of excavations, gravel pits, cuts, etc., note stratification. b. Experiment to show sedimentation, using samples of soil suspended in water. c. Gather information, preferably from student observation, of faults, folding and unconformities.	a. The sedimentary rocks—gravel, sand, and mud, have been sorted by water and laid down in strata. b. Younger beds of strata rest upon older beds, and thus age can be determined. c. Earth movements cause faults and unconformities. d. Key fossils help in determining the ages of rocks.
6. To appreciate the age of the earth through a study of geological eras and related life forms.	a. Examine any available samples of fossils, and obtain literature on fossils in Alberta. b. By use of charts, oral and written reports and discussions, thoroughly familiarize students with the main geological eras and their characteristics. c. Establish the significance of knowledge about geological eras with respect to oil exploration in Alberta.	a. The five main geological eras are named according to the type of life that existed in each period of time named. b. Mountain building and erosion took place in all eras. c. Fossils first appeared in the Paleozoic era since previous forms of life had no skeletons. d. Alberta formations contain a wealth of information concerning the Reptilian or Mesozoic era. e. Remains of man are found only in the latter part of the most recent period of the Cenozoic era. f. Our era — the Cenozic — has been characterized by four "great ice ages".

UNIT THREE—HEAT

1. References:

Hogg, et al, *Physical Sciences For Canadian High Schools.* pp. 119-157.
Eby, et al, *The Physical Sciences.* pp. 188-191.
Dull, *Modern Physics. pp.* 203-269.

2. Major Concept:

Heat energy is molecular motion. Man's understanding of heat has enabled him to control his environment.

3. Generalizations:

a. The sun is the chief source of heat and other sources can be traced to the sun. (Specific purpose 1.)

b. Conduction, convection, and radiation are important in the control and use of heat. (Specific purpose 3.)

c. Most substances expand when heated and contract when cooled. (Specific purpose 4.)

d. The temperature of a substance and its form (gas, liquid, or solid) are explained by the behavior of its molecules. (Specific purposes 2, 4, and 5.)

UNIT III—HEAT

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
1. To develop a realization that man uses heat from many sources.	a. Demonstrate that heat can be obtained from many sources. b. Trace various sources of heat to the sun. c. Study the various methods of producing heat and compare them as to their relative usefulness.	a. Man is dependent on heat for warmth, food, energy. b. The sun is the chief source of heat for the earth. c. Sources of heat that can be controlled are essential to man to meet his special needs. d. These sources are combustion and electricity.
2. To differentate clearly between "heat" and "temperature".	a. Study the various types of thermometers and the two common thermometer scales. b. Compare temperatures and heat in various bodies to make clear the meaning of each.	a. Heat is the total kinetic energy of the moving molecules of a body. b. Temperature is the degree or intensity of heat of a substance. It depends upon the average kinetic energy of the molecules.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
	c. Learn to calculate the amount of heat lost or gained with changes in temperature of a given body of water, and to express the amounts in units of measurement. d. Relate previous study of molecular motion to the explanation of heat and temperature. e. Practice converting "C" readings to "F" readings and vice versa.	c. The amount of heat in a body depends upon its mass, temperature, and the nature of the material. d. For special purposes, special thermometers are used.
3. To understand the various phenomena of heat transferance that enable man to utilize heat.	a. Demonstrate conduction of heat in different substances. b. Illustrate and study convection currents in liquids and gases (air). c. Study absorption and radiation of heat. d. Study the application of these facts to various practical problems, such as heating systems and clothing design.	a. Heat travels by convection, conduction, and radiation. b. In conduction, energy is transmitted from molecule to molecule; in convection, the molecules of fluids move from place to place carrying the heat energy. Radiation is electromagnetic waves. c. Some substances are good conductors of heat; others are poor conductors or good insulators. d. Man uses his knowledge of heat transfer to provide more comfortable living. c. Convection currents in air and water account for winds and ocean currents.
4. To associate expansion and contraction with many mechanical devices, natural phenomena, and problems in engineering.	a. Investigate to find whether substances expand when heated and contract when cooled. b. Find and study applications of expansion and contraction to practical uses and problems, e.g. steel bridges, thermostats, etc.	a. Changes in the temperature of substances result in expansion or contraction. b. Gases expand more than liquids and solids when heated, and all gases behave alike.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
	c. Explain expansion and contraction in terms of molecular motion.	c. Liquids expand more than solids, but different liquids and solids have different coefficients of expansion. d. When gases are compressed the temperature rises; when they are allowed to expand the temperature falls.
5. To develop a realization that the ease with which water may be converted into the gaseous state affects man's comfort and convenience.	a. Study the difference in conditions of molecules in steam and water. b. Determine the temperature at which water and other liquids boil. c. Study the principle of the pressure cooker and the vacuum pan. d. Study the concept of latent heat and its application to steam heating and refrigeration.	a. The difference in the rates of movement of molecules determines whether water is a gas, liquid, or solid. b. The changes of state of water from solid to liquid, and liquid to vapor, require additional energy. c. The temperature at which water boils depends upon external pressure.

UNIT FOUR—WEATHER

1. References:

Hogg, et al, *Physical Sciences for Canadian High Schools*. pp. 161-193.
Eby, et al, *The Physical Sciences*. pp. 93-115.

2. Major Concept:

The forecasting of weather requires a knowledge of the properties and behavior of the earth's atmosphere.

3. Generalizations:

a. Weather is an important factor in man's daily life and activities. (Specific purposes 1 and 2.)

b. Forecasting weather requires scientific observation and measurement of atmospheric conditions over vast areas of the earth's surface. (Specific purposes 3 and 7.)

c. Weather is the result of changes in the atmosphere, especially in the troposphere. (Specific purposes 2, 4 and 6.)

d. The movements of air masses on the earth's surface are related to temperature changes and the rotation of the earth. (Specific purpose 5.)

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
1. To develop an appreciation of how weather affects man's activities.	a. Make a list of activities of man affected by weather. b. Discuss the effect of weather upon specific occupations. c. Investigate man's attempts to control weather, e.g. smudge-pots, cloud-seeding.	a. Weather affects man's comfort, travel, and occupation. b. Weather affects some occupations more seriously than others. c. Man has had little success in controlling weather.
2. To encourage an interest in recording weather conditions.	a. Study weather reports and records concerning Alberta. b. Recall and record observations made by pupils of weather.	a. Alberta has characteristic weather conditions. b. A knowledge of Alberta weather records assists us in planning activities, e.g. stampedes, carnivals.
3. To understand that the movements of earth's atmosphere are significant to weather and climate.	a. Study a cross-section of the earth's atmosphere in relation to temperatures, moisture content, etc. b. Study movements of the earth's atmosphere caused by unequal heating and the earth's rotation. c. Locate Alberta's position in the wind-belts of the earth at different seasons.	a. Climate is "average" weather over a long period of time. b. Key factors in causing weather conditions are convection currents in the atmosphere and the movement of air masses. c. The "prevailing westerlies" which influence Alberta's weather, result from convection currents and the direction of the earth's rotation. d. The invasion by air masses is another dominant factor in weather conditions.
4. To develop skill in reading the "weather messages" carried by the clouds.	a. Review evaporation and condensation. b. Find the dew-point in the classroom and discuss relative humidity. c. Observe and record cloud formations over a period of time. d. Study classifications and forms of clouds.	a. Evaporation and condensation occur in the troposphere. b. A dew-point exists for one mass of moist air. c. Condensed atmospheric water vapor produces clouds. d. Clouds are classified according to altitude.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
5. To develop an appreciation of the importance of air-mass invasion to the weather of Alberta.	a. Study the natures and causes of air masses, cold and warm fronts, cyclones and anti-cyclones. b. Observe and discuss the formation of cold and warm fronts. c. Study weather maps for interpretation of air mass movement.	a. Polar air mass invasions dominate Alberta weather. b. Cold and warm fronts are produced when air masses move into regions of different temperature. c. Cyclones and anticyclones move across Alberta in succession, bringing characteristic changes.
6. To develop an appreciation of the importance of special weather features in a locality.	a. Recall temperature changes caused by compression, and apply to chinook winds. b. Learn the story of a hailstorm. c. Study the origin and characteristics of Alberta blizzards. d. Note the effects of these special weather conditions upon the economy of Alberta.	a. The chinook wind has a great effect on the weather of some Alberta localities. b. Hail storms seriously affect farmers in parts of Alberta. c. Blizzards in Alberta constitute a serious hazard.
7. To develop a scientific attitude toward weather forecasting.	a. Find out how information is gathered by weather forecasting. b. Study various weather instruments — barometer, maximum-minimum thermometers, etc., and obtain reports upon local meteorological recording agencies. c. Record weather forecasts from radio and newspaper, and compare against actual conditions. d. Make a collection of weather sayings and discuss their validity as a basis for forecasting — e.g. groundhog, moon, skies, etc. e. Study the symbols used on weather maps and methods of forecasting.	a. Weather forecasting is a science. b. Information is gathered by the use of special instruments. c. Weather information from wide areas is transmitted to central points. d. By the use of special symbols, weather information is recorded on maps daily. e. Specially-trained scientists make forecasts from these maps. f. Continuously changing conditions introduce error and impose a time limit for validity of forecasts.

UNIT FIVE—FIRE AND FUELS

1. References:

Hogg, et al, *Physical Sciences For Canadian High Schools*. pp. 197-265.
Eby, et al, *The Physical Sciences*. pp. 463-468.
Black and Conant, *New Practical Chemistry*. pp. 31-58.

2. Major Concept:

Combustion is a fundamental chemical process, and is a very important factor in man's use and control of his environment.

3. Generalizations:

a. Combustion is a chemical reaction in which fuels combine with oxygen. (Specific purposes 1 and 2.)

b. Carbon and hydrogen are the elements involved in the combustion of fuels. (Specific purposes 3 and 4.)

c. Fire must be controlled in order to prevent destructive fires and explosions. (Specific purposes 5 and 6.)

d. Our most important fuels are coal, oil, gas, and wood products. (Specific purposes 7, 8, 9 and 10.)

UNIT V--FIRE AND FUELS

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
1. To investigate the nature of ordinary combustion.	a. Observe common examples of combustion and record, with a view to attempting explanations of phenomena. b. Study slow combustion — rusting, respiration, oily rags. Record common factors and discuss kindling temperature.	a. Air, and its component, oxygen, are necessary to combustion. b. Heat, light, smoke, ashes are characteristic of a rapid combustion. c. Slow combustion requires oxygen. d. All combustible materials have a minimum temperature to which they must be heated before they take fire. This is called the ignition point.
2. To develop an appreciation of Lavoisier's use of the Scientific Method in his explanation of burning.	a. Inquire briefly into the attempts of early scientists to explain combustion—the Phlogiston Theory. b. Study Lavoisier's and Priestley's classical experiments with mercuric oxide.	a. The erroneous theory — the Phlogiston Theory — failed to account for the role of oxygen in combustion. b. Substances gain in weight as a result of combustion. although they may appear less, because of loss of gaseous products.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
	c. Perform experiments to indicate the nature of oxides, and to illustrate direct combination of elements to form compounds.	c. Lavoisier, by accurate weighing and experimentation, demonstrated the vital role of oxygen in combustion. d. An oxide is a compound of an element and oxygen. e. In a chemical change, new substances are formed, and heat and light may evolve.
3. To appreciate the importance of the special properties of pure oxygen.	a. Study experimentally the properties of pure oxygen.	a. Oxygen may be obtained from many of its compounds. b. Potassium chlorate readily yields oxygen when heated, especially in the presence of manganese dioxide. c. Substances burn more vigorously in oxygen.
4. To develop an appreciation of the fact that hydrogen always forms water when it burns.	a. Study experimentally the preparation and properties of pure hydrogen. b. Study the combustion of some hydrocarbons, such as paraffin or natural gas.	a. Hydrogen can be readily liberated from acids by reaction with metals such as zinc. b. Hydrogen burns, but does not support combustion. It forms an *explosive* mixture with air. c. The combustion of hydrogen is represented by the equation $2H_2+0_2 \rightarrow 2H_20$. d. The products of the complete combustion of a hydrocarbon are CO_2 and H_2O. e. The color of the flame is an indication of the completeness of combustion and the temperatures obtained.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
5. To realize the need for care in the handling of combustible and explosive materials.	a. Study the chemistry of matches. b. Gather information about fires caused by dust and gas explosions, and the use of the Davy safety lamp. c. Study simple chemical equations illustrating that gases result from explosions. d. Study the chemistry of the internal combustion engine, and its exhaust gases. e. Study the composition and uses of some explosives.	a. Most matches contain compounds of phosphorus, which have a low ignition point, and are readily ignited by friction. b. Combustible materials in the form of a fine dust or gas form explosive mixtures with air. c. The force of an explosion is caused by the formation and sudden expansion of the gaseous products. d. Properly controlled explosions are useful to man as a source of energy.
6. To understand the chemistry of fire control.	a. Perform simple experiments to illustrate the principle involved in extinguishing of fire. b. Study the chemical reactions involved in the operation of various fire extinguishers.	a. To extinguish a fire the combustible material must be cooled below its kindling point, or the air excluded. b. Certain fire extinguishers utilize specific chemicals to form and eject substances which extinguish fires.
7. To provide an insight into the importance of oil as a fuel.	a. Study the geological aspects of oil formation in Alberta. b. From pamphlets and books, find out how oil is located and extracted. c. Locate the oil and gas fields, refining centres, and pipelines of Alberta. d. Study the processes of fractional distillation and cracking, and the manufacture of synthetic gasoline. e. Discuss some uses of the products of Alberta oil fields.	a. The two essential geological conditions for the accumulation of oil are a source bed and a trap. b. Oil is probably formed by the decomposition of fish or diatoms. c. The constituents of crude petroleum, gasoline, kerosene, etc., may be separated by fractional distillation. d. Gasoline is a mixture of the lower hydrocarbons. e. Alberta is one of the most important new oil producing areas of the world.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
8. To develop appreciation of the value of coal as a source of energy for man.	a. Review geological aspects of coal formations. b. Collect samples of different forms of coal and experiment with distillation. c. Have pupils report on methods of coal mining in Alberta. d. Make charts showing the by-products of coal.	a. Coal was formed millions of years ago from plant materials. b. Successive changes convert vegetation into peat, lignite, bituminous coal, and anthracite. c. Destructive distilllation of bituminous coal produces coke, tar and coal gas. d. Coal tar is the source of many important chemical substances. e. Alberta has vast deposits of coal.
9. To realize that the use of gas as a fuel affects our daily living in many ways.	a. Study the production and purification of various fuel gases. b. Make a special study of natural gas development in Alberta. c. Prepare and burn acetylene.	a. Natural gas, propane and coal gas have the highest heat values of the fuel gases and consist chiefly of methane and hydrogen. b. Water gas is cheap and is used extensively in industry. It contains a high percentage of carbon monoxide. c. Alberta natural gas is an important fuel. d. By varying the proportions of an oxygen-acetylene mixture, flames of different temperatures can be obtained, which are useful in metal work.
10. To appreciate the fact that photosynthesis and combustion are complementary processes in nature.	a. Study exhaled air to show that respiration is an oxidation process. b. Study photosynthesis and its relation to chlorophyll in the green leaf. c. Chart the carbon dioxide cycle.	a. Combustion and respiration tend to increase the carbon dioxide content of air; photosynthesis and solubility in water tend to reduce it. b. Respiration involves the combustion of carbohydrates produced in plants by photosynthesis.

UNIT SIX—MACHINES AND ENGINES

1. References:

Hogg, et al, *Physical Sciences For Canadian High Schools*. pp. 269-315.
Eby, et al, *The Physical Sciences*. 191-213 and 215-259.
Dull, *Modern Physics*. pp. 270-284.

2. Major Concept:

Man's control of his environment has been tremendously increased by the invention and use of machines.

3. Generalizations:

a. Machines are based on six simple devices. (Specific purpose 1 and 2.)

b. Machines have enabled man to do work more easily and more quickly. (Specific purpose 4.)

c. The use of chemical energy to operate machines has greatly extended their usefulness. (Specific purpose 5.)

UNIT VI—MACHINES AND ENGINES

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
1. To contemplate early man's problems, and to appreciate his attempts to overcome them through the invention and use of machines.	a. Read, report upon, and discuss early man's discovery and use of machines.	a. Man's limited physical strength curtailed his plans and achievements. b. Early man devised various machines to overcome problems. c. Using a variety of simple machines, man accomplished phenomenal tasks.
2. To observe and be able to recognize various types of machines.	a. Gather into the laboratory for examination, appropriate examples of machines which can be analyzed into the six simple types of machines. b. Trace the adaptation of these six simple machines as they exist in more complex machinery.	a. There are six simple devices, all over 3,000 years old, which form the basis of our present day machines. b. Each of these devices has some characteristics which can be identified. c. Adaptations of these devices may be recognized in modern machinery.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
3. To establish a basic vocabulary needed to study and understand machines.	a. Develop the scientific concepts of work and power. b. Learn the units of measurement and solve simple problems in work and power.	a. Pushing and pulling do not constitute work. Force must be applied through a distance, or to cause motion, before work is done. b. A source of energy must be available to supply force. c. The amount of force available determines the time required to do a given amount of work. d. The term "power" indicates the rate of doing work, and derives from force, distance and time. e. Man has devised units of measurement to apply to all these terms.
4. To establish and understand fully the principles which make machines of use to man.	a. Using experiments and demonstrations, illustrate the purposes for which machines are used. e.g. Inclined planes, pulleys, bicycles, etc. b. To develop the concept of mechanical advantage, establish and chart applied force, distance through which it is applied, and work done. c. Compare the mechanical advantages of various machines. d. Perform many calculations of problems relating to work, power and efficiency.	a. Machines may be used to do work; they are designed to utilize a limited force available, or to create changes in speed. b. Machines permit less force to act through a greater distance. c. The ratio of *the distance through which force is applied to the distance though which the resistance moves* is known as mechanical advantage. d. According to the purpose of the machine, M.A.'s both greater and less than 1 may indicate usefulness of the machine. e. Work output never equals work input. f. The term "efficiency" indicates what proportion of the work input is utilized by the machines to cause useful work output as intended.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
5. To understand the basic principles and characteristics of three important types of engines which operate man's machines.		
(1) The Steam Engine.	a. Review briefly the history and problems related to the development of steam power.	a. The invention of the steam engine brought with it social problems as well as social progress.
	b. Study methods of supplying steam to engines, and compare their efficiencies.	b. The conversion of energy from one form to another common to all engines, is accomplished in three steps in steam engines.
	c. Study the operation of the simple reciprocating steam engine.	c. Various types of machines operated by steam have been devised for such specific purposes, and to improve efficiency and mechanical operation.
	d. Trace the conversion of energy from fuel to work accomplished.	
	e. Study the principles and design of the steam turbine.	d. The steam turbine is well adapted to work requiring constant high speed.
(2) Internal Combustion Engines.	a. Using models or films study thoroughly the operation of a four cycle engine.	a. Internal combustion engines overcome certain disadvantages and limitations of steam engines.
	b. Review the chemistry of fuel as covered in Unit 5, and study the introduction and combustion of fuels in internal combustion engines.	b. They use two new principles to convert energy to power.
	c. Study the special features of the diesel engine.	c. The various parts perform specific synchronized functions.
		d. Diesel engines utilize principles differing from those of gasoline engines.

SPECIFIC PURPOSES	SUGGESTED PROCEDURES	UNDERSTANDINGS
(3) Gas Turbines, Jets and Rockets.	a. Discuss the principles, designs, and useful characteristics of gas turbines, jet engines, and rockets.	a. More recent developments of machines overcome limitations of earlier mankind. b. These three engines apply principles which have widened the horizons of man's achievement. c. Jets and rockets utilize the principle contained in Newton's third law.
6. To understand the basic principles of operation of one of man's most important applications of power from engines —airplanes.	a. Demonstrate the Bernoulli effect and show its relation to aircraft operation. b. Show the significance of upward force on airplane wings as a factor in lift. c. Discuss aircraft design in relation to principles which make possible and which improve performance. d. Study the relationship between improved engines and aircraft design and performance. e. Review and establish the principles basic to airplane control and navigation.	a. The relatively recent development of the airplane has revolutionized human association and endeavor. b. Modern airplanes are the result of man's development of better engines. c. Bernoulli's principle is basic to the operation of heavier-than-air craft. d. Two component forces—the lift and the propeller thrust—operate to overcome the weight of the plane and the drag. e. Four main controls direct the motion of the plane; four main instruments serve to make accurate navigation possible.

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